Journal of Experimental Psychology:
Human Learning and Memory
1979, Vol. 5, No. 6, 585–597

Comprehension of Antonymy and the Generality of Categorization Models

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Three experiments investigated antonym comprehension, that is, the judgment that two words are or are not antonyms. In Experiment 1, the latency of *yes* responses to antonyms decreased with degree of antonymy. In Experiment 2, *no* responses to nonantonym pairs were slower for pseudoantonyms (e.g., popular–shy) than for synonyms and unrelated words that did not differ from each other. In Experiment 3, subjects made either antonym judgments or synonym judgments for the same set of antonyms, synonyms, pseudoantonyms, pseudosynonyms, and unrelated words. The no responses were slowest for pseudoantonyms in the antonym task and for pseudosynonyms in the synonym task. Categorization models can explain these results if it is assumed that processing is a function of *relationship similarity,* the degree to which the relationship between members of a stimulus pair exemplify the relationship being judged by the subject.

Comprehension of category relationships has been investigated extensively in recent years, and several models have been proposed that provide fairly good accounts of category comprehension findings (Smith, 1977). The progress made in investigating category comprehension makes it appropriate to consider what kind of model would provide a general account of the comprehension of semantic relationships. A general model should, for example, be able to explain comprehension of relationships like antonymy and synonymity in addition to categorical relationships. Although categorization models were not explicitly designed to provide a general account of semantic relationships, the task of developing a general model may reasonably begin by applying categorization models to other semantic relationships. The general purpose of the present research is to determine whether categorization models can account for the comprehension of antonymy and synonymity.

Current categorization models explain the effects obtained in categorization tasks in terms of the similarity (or associative connectedness) of items in a stimulus pair presented for comprehension. Since this similarity involves a relationship between items, these models can be said to rest on *item similarity*. Besides item similarity, another kind of similarity that has not been explicitly noted before may affect semantic judgments. This is the *relationship similarity* that exists between the relationship that subjects are asked to judge and the relationship between the two words presented. For example, *robin–bird* are not only more similar to each other (i.e., higher in item similarity) than *duck–bird*, but the relationship of *robin–bird* is a better example of the subordinate–superordinate relationship than that of *duck–bird*.

For category relationships, item and relationship similarity covary, which may be the reason that the difference between the two has not been noted. However, when other semantic relationships are considered, especially antonymy, the necessity of sepa-

The authors thank Christopher Peterson for valuable comments on an earlier draft of this article.

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rating item similarity and relationship similarity becomes apparent. In an antonym-comprehension task in which word pairs are judged as antonymous or not, item and relationship similarity do not covary, at least for nonantonym pairs. A nonantonym pair such as *smart–intelligent* is higher in item similarity than an unrelated pair like *dark–salty*, but both pairs are equally devoid of similarity to the task relationship of antonymy. A nonantonym such as *strong–diseased* is also higher in item similarity than an unrelated pair but is, in addition, high in relationship similarity.

The specific purpose of the present research was to determine whether an effect of relationship similarity, separate from item similarity, would be found for judgments of antonymy (Experiments 1, 2, and 3) and judgments of synonymity (Experiment 3). An effect of relationship similarity on antonym and synonym judgments would indicate that categorization models must be modified to account for relationship similarity if they are to serve as general models of semantic decisions.

Before describing the present experiments, it is necessary to first review the effects of similarity on categorization judgments that have motivated current models and, second, provide a theoretical description of antonymy. Categorization experiments commonly examine one of three kinds of judgments of category membership: deciding one word is (a) subordinate to another, (b) superordinate to another, or (c) coordinate to (in the same category as) another. Consider the effects of similarity on, for example, the coordinate decision that two words belong to the same category or to different categories. The latency of same category decisions is faster when the two coordinates are more similar, for example, *hawk–eagle*, than when they are less similar, *hawk–bluejay* (Shoben, 1976). In contrast, when members of a stimulus pair are from different categories, the latency of different decisions is slower to pairs composed of similar words, for example, *tulip–oak*, than to unrelated pairs, such as *tulip–rock* (Herrmann, Shoben, Klun, & Smith, 1975; Shoben, 1976).

Analogous effects have been found in a synonym judgment task. Herrmann, Papperman, and Armstrong (1978) asked subjects to decide whether two words were synonyms or not. Yes decisions were facilitated by similarity between synonyms, and no decisions were impeded by similarity between nonsynonyms. These effects of similarity in the synonym task can be explained by current categorization models without modification, since all models base their explanation of the categorization task on the similarity in meaning of the words in a stimulus pair.

Judgments of antonymy, however, cannot be related to similarity between items in a straightforward manner. Antonyms are two words that are opposed in meaning and whose opposition occurs on those features that represent the denotation[1] of both words. Opposition which occurs on features that are connotative for one or both words is neither necessary nor sufficient for antonymy (Lyons, 1968; *Webster's New Dictionary of Synonyms*, 1973). As an example of how a denotative dimension of opposition serves as the basis of antonymy (Palermo, 1978), consider the pair *married–single*. These words are opposed on the dimension of "whatever might be the culturally accepted criteria of 'marriageability'" (Lyons, 1968, p. 461). Because the marriageability dimension is denotative

[1] The term *denotative meaning* is used here (as defined by Glucksberg & Danks, 1975; see Herrmann, 1978) to represent the "generic" sense of the word, that is, those properties of a word that permit it to be used appropriately. Denotative meaning is distinguished from connotative meaning, which rests on a word's associative or affective properties that do not determine the appropriate use of a word. It may be noted that the denotative/connotative distinction has also long been used to define synonymity, since agreement on connotative features alone is not sufficient for synonymity (Herrmann, 1978). Also, a distinction analogous to the denotative/connotative one has been employed in one categorization model (Smith et al., 1974) in which judgments of category membership are assumed to rest on agreement in *definitional* rather than *characteristic* meaning.

for both *married* and *single*, these words are antonyms. Connotative properties associated with being married or single, such as being or not being a parent, do not serve as the basis of antonymy for this pair. The requirement that the dimension of opposition include the denotative features of both words is needed to discriminate antonyms from pseudoantonyms like *strong–diseased*, which are opposed but which are not antonyms. The dimension of opposition for this pair includes features that are denotative for *strong* but that are connotative for *diseased;* diseased connotes *weak*, which is an antonym of *strong*.

Antonyms can vary in degree of antonymy, the degree to which they are good representatives of the relationship of antonymy (Baird, 1972; Fijalkow, 1973; Lazerson, 1977), just as category members can vary in the degree to which they are typical of a category (Rosch, 1973). Variations in degree of antonymy are due to properties of the dimension of opposition between the two words. First, the denotative dimension of opposition is easier to identify for some antonyms (e.g., *good–bad*) than for others (e.g., *holy–evil;* Palermo, 1978). Second, degree of antonymy is influenced by properties that are characteristic of opposites in general. Semantic opposition is increased by the symmetry of pair members about the midpoint of the common dimension (Katz, 1972; Mordkoff, 1963; *Webster's New Dictionary of Synonyms*, 1973), increased extremeness in values of one or both members of a pair (*Webster's New Dictionary of Synonyms*, 1973), and increased number of opposed values on features making up the dimension of opposition. Degree of antonymy is thus determined by the degree to which the opposition between two words meets criteria for antonymy and opposition; that is, it is determined by relationship similarity, not by item similarity. Word pairs that are high in degree of antonymy may be higher in item similarity than low antonymy pairs but it is not item similarity per se that makes a pair antonymous or one pair more antonymous than another.

Nonantonym pairs can also vary in relationship similarity, that is, in the degree to which they approximate the antonym relationship, just as category–nonmember pairs can vary in their approximation to the superordinate–subordinate relationship. For example, pseudoantonyms (e.g., *strong–diseased*) are higher in relationship similarity in an antonym task, than unrelated pairs, (e.g., *dark–salty*). Moreover, as discussed earlier, relationship and item similarity can be separated in nonantonym pairs. Synonyms (e.g., *smart–intelligent*) are high in item similarity but are as low in similarity to the antonym relationship as unrelated pairs.

The effects of item and relationship similarity can, therefore, be separated in an antonym judgment task. An effect of item similarity alone on antonym judgments would allow categorization models, in their present form, to account for antonym judgments. An effect of relationship similarity or the absence of an effect of item similarity would be inconsistent with current models; such results would indicate that current models must be modified if they are to provide a general account of semantic judgments.

The present research was designed to determine whether parallels to the similarity effects found in categorization and synonym tasks occur in the antonym task and also to determine whether such effects should be attributed to item or relationship similarity. Experiment 1 examined the effect of relationship similarity on yes responses in an antonym task by varying the degree of antonymy of antonym pairs. Experiment 2 examined the effects of relationship and item similarity separately on the no responses by comparing the latencies of nonantonym judgments for pseudoantonyms, synonyms, and unrelated words. Experiment 3 replicated Experiment 2 and also investigated the effect of item and relationship similarity on synonym judgments.

Experiment 1

As we have described, high antonym pairs are opposed on a more salient dimension (e.g., *good–bad*) than low antonym pairs (e.g., *holy–evil*), and/or are more opposed on general aspects of opposition, for example, symmetry of opposed values about a dimension's midpoint. Consistent with this account, several investigators have found that antonym pairs vary in how well they exemplify the relationship of antonymy (Baird, 1972; Fijalkow, 1973; Lazerson, 1977). If relationship similarity affects the judgment that a stimulus pair is antonymous, then yes response times should be faster for antonyms that are better examples of antonymy. Such an effect would parallel the facilitating effect of similarity on yes responses in the categorization and synonym tasks.

Method

Subjects. Thirty students of Hamilton and Kirkland colleges were paid $1 each to complete a questionnaire on degree of antonymy. Twelve additional students performed an antonym judgment task for $2 each.

Materials. A questionnaire on degree of antonymy presented 80 opaque antonym pairs, that is, pairs in which neither member bore a prefix or suffix to indicate negation. The 80 pairs consisted of 40 dichotomous antonym pairs (e.g., *alive–dead*) and 40 continuous antonyms (e.g., *wet–dry*).[2] Subjects performing the rating task indicated a pair's degree of antonymy on a 5-point scale, with 1 representing "not antonyms"; 2 "barely antonyms"; 3 "poor antonyms"; 4 "good antonyms"; and 5 "exact antonyms." From the ratings of degree of antonymy, 40 pairs were selected to be antonym stimuli in the antonym judgment task. Twenty high antonym and 20 low antonym pairs were selected, with an equal number of dichotomous and continuous antonyms in each condition. The mean rating was 4.55 for high antonym pairs ($SD^2 = .512$) and 3.55 for low antonym pairs ($SD^2 = 1.708$). The two conditions were equated in mean word length ($M = 6.5 \pm .6$ letters) and in mean printed frequency ($M = 76.1 \pm .6$, Kučera & Francis, 1967).

Nonantonym pairs consisted of 40 pseudoantonym pairs (e.g., *popular–shy*). Each pseudoantonym pair was constructed by a procedure derived from the account of antonyms and pseudoantonyms given in the Introduction. An antonym pair (e.g., *popular–unpopular*) was selected from an antonym dictionary such as the *Webster's New Dictionary of Synonyms* (1973). An associated attribute was then generated by us for one member of the antonym pair (e.g., *shy* from *unpopular*), such that the attribute was associated with but not identical to the denotative dimension on which the antonym pair was contrasted. (*Shyness* represents a value on the "intraversion–extraversion" dimension that is associated with the "popularity" dimension.) The associated attribute was then substituted for the item that spawned it, giving the pseudoantonym pair *popular–shy*. The 40 pseudoantonyms constructed for use in the experiment matched the antonyms in mean word length ($M = 6.1$ letters) and mean printed frequency ($M = 77.9$).

The antonyms consisted of 38 adjective and 2 verb pairs evenly divided between high and low conditions. The nonantonyms consisted of 37 adjective pairs and 3 verb pairs. In addition, a stimulus display contained the unmarked member in the top position and the marked member (Clark, 1969) in the bottom position for 11 of the 20 high antonym pairs, and for 13 of the 20 low antonym pairs.

Apparatus. Antonym and nonantonym pairs were typed in uppercase, centered one word above the other, and were presented in a three-channel tachistoscope (Iconix, Model 6137). The tachistoscope presented an adaptation field in the first channel, a fixation field containing two horizontal lines in the second channel, and the word pair in the third channel. Subjects responded with one of two microswitches that were held one in each hand. Latency was measured to an accuracy of ± 1 msec by an Iconix 6246 Response Buffer.

Procedure. Subjects were instructed to classify pairs as antonyms or nonantonyms by pressing the appropriate microswitch. Handedness for antonym and nonantonym responses was counterbalanced across subjects. Instructions specified that responses should be accurate and rapid. The subjects classified 12 practice pairs and then the 80 stimulus pairs that were presented in one of two different random orders.

Results

The mean response times for correct yes responses and error rates were computed as a function of degree of antonymy. These data were based on 11 subjects, since 1

[2] Although there are several kinds of semantic opposition and contrast, only two kinds (dichotomous and continuous) have been consistently regarded as antonymous. (The introduction of the *Websters's New Dictionary of Synonyms*, 1973, gives a thorough discussion of antonym classification; see also Leech, 1974; Lyons, 1977.) The present experiment used only these two clearest types of antonyms. The results obtained for dichotomous and continuous antonym relations cannot, therefore, be generalized, without qualification, to judgments of relationships that resemble antonymy but that are logically different, for example, relatives or converses (*father–son; question–answer*), incompatibles (*frank–hypocritical; vigilant–careless*), contrastive terms (*silver–gold; sugar–salt*), and heteronyms (*considerate–metallic; dog–balloon*). As explained in the text, contrast or opposition is not, itself, a sufficient condition for antonymy and should not be confused with it (Katz, 1972; Leech, 1974; Lyons, 1968, 1977).

subject was eliminated from the analysis for having made an excessive number of slow responses. (This subject made five responses of more than 10 sec, whereas the remaining subjects made no more than one such response.) The results for yes responses were evaluated using the *min* F' statistic based on separate analyses of variance in which subjects and stimulus pairs were treated as a random factor (Clark, 1973). In all analyses reported in this article, the .05 level of significance was used. To simplify presentation, only the mean square error terms from the analysis of subject means are reported. The mean latency for correct yes responses to antonym pairs was faster for high antonym pairs (1.445 sec) than for low antonym pairs (2.255 sec), *min* $F'(1, 4.5) = 8.39$, $MS_e = .218$. The error rate also varied with degree of antonymy: 2.0% for high antonym pairs, and 18.3% for low antonym pairs, *min* $F'(1, 4.5) = 8.77$, $MS_e = .855$. The mean latency of correct no responses to pseudoantonym pairs was 2.222 sec, and the error rate to these pairs was 8.0%. The mean latency of errors, computed for conditions with a sufficient percentage of errors (5%), was 2.898 sec for low antonyms and 2.432 sec for pseudoantonyms.

Discussion

Responses were faster to high antonym pairs than to low antonym pairs. This effect of degree of antonymy parallels the effects of similarity on same–different categorization decisions (Smith, 1977) and degree of synonymity on synonym decisions (Herrmann et al., 1978).

The effect is most readily described in terms of relationship similarity; high antonym pairs were better examples of the relationship being judged than low antonym pairs. However, the effect can also be attributed to item similarity, since high antonym pairs, for example, *guilty–innocent*, might be expected to be higher in item similarity than low antonym pairs, for example, *holy–evil*. Although antonym decisions cannot, presumably, be based on item similarity alone, the results of this experiment do not rule out the possibility that item similarity plays a role in antonym judgments.

Experiment 2

Although item and relationship similarity may be confounded in antonym pairs, these two variables can be separated in nonantonym pairs. Experiment 2 was designed to determine the effect of the two variables in an antonym task. A second purpose was to determine whether no responses in an antonym task, like yes responses, show an effect parallel to those obtained in categorization and synonym tasks. Both of these purposes were realized in Experiment 2 by presenting nonantonyms in the antonym judgment task that included pairs of unrelated words (*reply–wonder*), synonyms (*deceive–cheat*), and pseudoantonyms (*believe–deny*). Item similarity was varied among these stimuli in that synonyms in particular, but also pseudoantonyms to some extent, possess more item similarity than unrelated words. Relationship similarity (the similarity of the relationship between a pair of words and the relationship being judged) was varied between pseudoantonyms and synonym pairs, since only pseudoantonyms have relationship similarity to the judgment being made. These three kinds of nonantonyms permit three models of antonym judgments to be tested. Each model predicts that the no responses will be impeded by either one or both types of similarity. First, a model based only on relationship similarity predicts slow responses for pseudoantonyms and equally fast responses for synonyms and unrelated pairs. Pseudoantonyms meet some of the criteria for antonymy, but synonyms and unrelated pairs meet none of the criteria.

Second, a model based solely on item similarity predicts that responses will be slower for synonyms and pseudoantonyms than for unrelated pairs and that depending on the particular items selected, responses to pseudoantonyms might be as slow as or faster than responses to synonyms. The third model is a hybrid, based on both relationship and item similarity. This model predicts that responses should be slowest for pseudoantonyms, since they possess both kinds of similarity; somewhat faster for synonyms, since they possess item similarity only; and fastest for unrelated pairs that have neither relationship nor item similarity.

A fourth prediction, derived from a misconception about the relationship between antonymy and synonymity, must also be discussed because this misconception is so widely held. Like the second model, this approach is based on item similarity, but antonyms and synonyms are placed at opposite ends of a single dimension on which unrelated words occupy the dimension's midpoint. According to this conception, the no responses should be fastest to synonyms, less fast to unrelated pairs, and slowest to pseudoantonyms. These predictions must be regarded as specious because they are based on an ill-founded assumption, the supposed opposition of antonymy and synonymy. As Lyons (1968) pointed out, "synonymy and antonymy are semantic relations of a very different logical nature: 'opposition of meaning' . . . is not simply the extreme case of difference in meaning" (p. 407). The opposite of synonymity is heteronymy, and the opposite of antonymy is lack of opposition. If the peculiar prediction that synonyms should be classified as nonantonymous faster than unrelated words is not supported, then we hope this study will have laid to rest the misconception underlying this misguided model.

In summary, Experiment 2 permits a choice among three models of antonym judgments, as well as an alternative but specious model. Support for either of the models in which relationship similarity plays a role should indicate that relationship similarity affects antonym judgments and may, therefore, affect other semantic judgments.

Method

Subjects. Seventeen undergraduates from Hamilton and Kirkland colleges participated in Experiment 2. Each was paid $2.

Apparatus. The apparatus was the same as that used in Experiment 1.

Materials. Antonyms consisted of 20 dichotomous antonym pairs: 17 adjective pairs and 3 verb pairs. The words had a mean length of 6.4 letters and a mean printed frequency of 78.8 (Kučera & Francis, 1967).

Nonantonyms consisted of seven pseudoantonym, seven synonym, and six unrelated pairs. The pairs were adjectives except for one verb pair in the pseudoantonym set, and one noun and one verb pair in the synonym set and in the unrelated set. The three nonantonym conditions were equated in mean word length ($M = 6.5 \pm .2$ letters) and in mean printed frequency ($M = 77.6 \pm .2$; Kučera & Francis, 1967). Examples of the three types of nonantonym stimuli are shown in Table 1.

Procedure

The procedure was the same as that used in Experiment 1, except that the subjects responded to 22 practice pairs and then to 40 experimental pairs. The experimental pairs were presented in five blocks of 8. Blocks, and pairs within blocks, were presented in one of two random orders. Each block contained 4 antonym and 4 nonantonym pairs. The nonantonyms in a block consisted of one pseudoantonym, one synonym, and one unrelated pair. The fourth pair was randomly selected from one of the three types of nonantonym pairs.

Results

The results for the no responses were evaluated using the *min F′* statistic (Clark, 1973). The analysis used an equal number of observations in each condition obtained

Table 1
Experiment 2: Examples of Nonantonym Stimuli in Antonym Judgment Task

Pseudoantonyms	Synonyms	Unrelated
Popular–Shy	Fine–Excellent	Physical–Legal
Strong–Diseased	Kind–Considerate	Classical–Intense
Believe–Deny	Deceive–Cheat	Reply–Wonder

Table 2

Experiment 3: Mean Latency of Correct Nonantonym Responses and the Percentage of Nonantonyms Classified as Antonyms as a Function of Stimulus Types

Item	Pseudoantonyms	Synonyms	Unrelated
Latency[a]	2.329 (2.001)	1.380 (1.401)	1.479 (—)
Error rates[b]	20.6 (18.5)	3.9 (3.4)	2.0 (—)

Note. Data in parentheses are based on responses to seven stimulus pairs; other data are based on six stimulus pairs.
[a] Data shown in seconds.
[b] Data shown in percents.

by randomly selecting and dropping one pair from the pseudoantonym and synonym conditions. Table 2 presents mean response times for correct responses and error rates for pseudoantonyms, synonyms, and unrelated words based on six pairs per condition. Additionally, the means for all seven pairs in the pseudoantonym and synonym sets are shown in parentheses. Inspection of the table indicates that response time was slower and the error rate higher for pseudoantonyms than for the synonym and unrelated pairs, which did not differ from each other. Overall, the analysis showed that the latencies of the no responses differed from each other, *min* $F'(2, 39) = 4.15$, $MS_e = .229$. A priori selected comparisons showed that responses were significantly slower to pseudoantonyms than to synonyms and unrelated pairs, but synonyms and unrelated pairs did not differ (*min* $F' < 1$).

The pattern of error data shown in Table 2 mirrored that for the latencies. However, the overall analysis indicated a significant difference only when based on subject means, $F_1(2, 30) = 19.25$, $MS_e = .326$, but not when based on means for stimulus pairs, $F_2(2, 15) = 2.03$, $MS_e = .894$, $p < .20$. The results of a separate analysis of the error rates for synonyms and unrelated pairs did not approach significance (*min* $F' < 1$). For yes responses the mean correct latency was 1.391 sec, and the error rate was 7.4%. The mean error latency to antonyms was 1.597 sec (11 subjects made this kind of error; the errors of 2 subjects whose latencies exceeded 8 sec were not included in this mean).

Discussion

The no responses were slower for pseudoantonyms than for synonyms and unrelated pairs, which did not differ from each other. The slower response time for pseudoantonyms represents an effect of relationship similarity; pseudoantonyms were higher in relationship similarity than synonym or unrelated pairs. There was no evidence of an effect of item similarity; synonyms and unrelated words that are, respectively, high and low in item similarity, did not differ.

The results, therefore, supported the model previously described in which relationship similarity alone is processed in antonym judgments. These data serve to reject the two models based on item similarity, either alone or in conjunction with relationship similarity. The findings also are inconsistent with predictions based on the misconception that antonyms and synonyms are opposites.

The results of Experiment 2 also have implications for those of Experiment 1, since it is improbable that the process of classifying a pair as not antonymous is fundamentally different from classifying a pair as antonymous. The finding that relationship similarity determined the latency of the no responses in Experiment 2 indicates that the effect of degree of antonymy on yes responses in Experiment 1 should also be attributed to relationship similarity. Although it is possible that item similarity also plays a role in antonym judgments, the lack of an effect of item similarity in Experiment 2 suggests that this variable was not relevant to the antonym judgments in Experiment 1.

Experiment 3

In Experiment 3 subjects performed either an antonym or a synonym judgment task. The same stimulus pairs were presented to all subjects and represented five types of semantic relationships: antonyms, synonyms, pseudoantonyms, pseudosynonyms, and unrelated pairs. The experiment had three purposes. First, the experiment was designed to replicate the results of Experiment 2, to strengthen the conclusion that antonym judgments involve relationship but not item similarity. Second, the experiment examined the effect of relationship and item similarity on another semantic judgment, synonymity. The effect of relationship and item similarity was thus evaluated separately for each task by a comparison of stimulus types within tasks, the same kind of comparison that was used in Experiment 2. The third purpose of the experiment was to compare performance on each stimulus type across tasks (e.g., to compare latencies for pseudoantonyms in the antonym and the synonym tasks) to provide a further test of conclusions about the role of relationship and item similarity in the two tasks.

It was expected that the effect of relationship similarity found in Experiment 2 would be replicated for the antonym group, that is, that responses would be faster for pseudoantonyms than for unrelated pairs, synonyms, and pseudosynonyms. It was also expected that as in Experiment 2, there would be no effect of item similarity and that responses to synonyms and pseudosynonyms would not differ from responses to unrelated pairs. An effect of relationship similarity was likewise expected for the synonym group. Responses were expected to be slower for pseudosynonyms than for unrelated pairs, antonyms, and pseudoantonyms. If item similarity affects the no responses in the synonym task, responses should be slower for antonyms and pseudoantonyms than for unrelated pairs, since antonyms have more properties in common than unrelated pairs (Weinreich, 1975). If item similarity has no effect, then response times for these stimulus types should not differ. Such a result would indicate that in the present task, synonym judgments were not based on an evaluation of degree of item similarity.

Comparison of each stimulus type across tasks provided additional tests of the effect of relationship similarity. It was expected that the relationship similarity of a stimulus type would be different in the two tasks; for example, pseudosynonyms are high in relationship similarity in a synonym task and low in an antonym task. Thus, responses to pseudoantonyms were expected to be slower in the antonym than in the synonym task, whereas responses to pseudosynonyms were expected to be slower in the synonym task than in the antonym task. Responses to unrelated pairs were not expected to differ in the two tasks, since the unrelated pairs were equally low in relationship similarity for both antonym and synonym judgments. Yes responses to synonyms were expected to be slower in the synonym task than no responses to these pairs in the antonym task, and, similarly, yes responses to antonyms were expected to be slower than no responses to these pairs in the synonym task. Synonym pairs should be rapidly rejected in the antonym task because they are not opposed; antonyms should be rapidly rejected in the synonym task because they do not possess sufficient features with similar values.

Method

Subjects. Twenty-six undergraduate students of Hamilton and Kirkland colleges were paid $2 for their participation in the experiment.

Apparatus. The apparatus was the same as that used in Experiments 1 and 2.

Stimulus materials. Twenty word pairs were constructed to represent each of five relationships: antonym, synonym, pseudoantonym, pseudosynonym, and unrelated word pairs. Pseudosynonyms were constructed in a manner analogous to that described for pseudoantonyms in Experiment 2. For example, for one member (*tardy*) of a synonym pair (*tardy–late*), a connotative attribute was generated (*slow*) and substituted for that member, yielding the pseudosynonyms (*slow–late*). As in Experiments 1 and 2, antonym stimuli were opaque and included dichotomous (11 pairs) and continuous (9 pairs) antonyms. The five sets of stimuli were composed of adjectives except for the pseudoantonyms, which included 1 verb pair. Two of the pseudoantonym and

4 of the antonym pairs came from the stimulus set used in Experiment 2. The five stimulus types were equated in mean word length ($M = 5.0 \pm .3$) and printed frequency ($M = 92.1 \pm .9$; Kučera & Francis, 1967).

Procedure

One group of 13 subjects was instructed to make antonym decisions, and another 13 subjects were instructed to decide whether words in a pair were synonyms. Both groups saw the same stimulus pairs; thus, 20% of the pairs in each group received a yes response. The instructions given to the two groups were identical except for the phrases specifying the target relationship for each condition, antonymy and synonymity. These instructions were similar to those in Experiments 1 and 2, except that the subjects were also informed as to the nature of the relationships present among pairs requiring a no response.

Results

Table 3 presents mean latencies for correct responses and error rates for yes and no responses as a function of the five types of word pair relations. In the antonym task, the no responses were slower to pseudoantonyms than to unrelated, synonym, or pseudosynonym pairs. In the synonym task, the no responses were slower to pseudosynonyms than to unrelated, antonym, or pseudoantonym pairs. The difference between the five types of pair relations was significant, *min* $F'(4, 178) = 4.46$, $MS_e = .036$, and the interaction of stimulus type and judgment task was significant, *min* $F'(4, 177) = 8.96$, $MS_e = .036$. The apparent tendency for responses to be faster in the antonym than in the synonym task was not significant (*min* $F' < 1.0$).

Selected comparisons shown to be significant by simple effects tests indicated that the interaction of judgment task with stimulus type was due to the difference between the two tasks in speed of responding to pseudorelation pairs. In the antonym task, responses were slower to pseudoantonyms than to all other types of nonantonyms, whereas in the synonym task, responses were slower to pseudosynonyms than to all other types of nonsynonyms. The tendency for nonsynonym responses to be slower to unrelated words than to antonyms did not reach significance. Comparing across tasks, responses to pseudoantonyms were slower in the antonym than in the synonym task, and conversely, responses to pseudosynonyms were slower in the synonym than in the antonym task.

Comparisons of yes and no responses by simple effects tests showed significant differences in the following instances: In the antonym task, yes responses were faster than no responses to pseudoantonyms. In the synonym task, yes responses were faster than no responses to pseudosynonyms and slower than no responses to antonyms. Comparing across tasks, synonyms were given a no response (in the antonym task) more quickly than a yes response (in the synonym task).

The pattern of results for errors mirrored that for response time. Error rates were higher for no responses to pseudorelation pairs than to other nonrelation pairs. The effect of relation type was significant, *min* $F'(4, 167) = 4.72$, $MS_e = 2.06$, as was the interaction of relation type with judgment task, *min* $F'(4, 175) = 13.38$, $MS_e = 2.06$, whereas judgment task alone had no effect (*min* $F' < 1.0$). Simple effects tests

Table 3
Experiment 3: Mean Latencies of Correct Responses (in msec) and Error Rates[a] *for Antonym and Synonym Judgments*

Judgment task	Antonyms	Synonyms	Pseudo-antonyms	Pseudo-synonyms	Unrelated words
Antonymy	1.274 (9.2)[b]	1.248 (6.2)	1.655 (22.3)	1.343 (1.9)	1.257 (.8)
Synonymity	1.206 (.4)	1.540 (14.2)[b]	1.340 (.8)	1.743 (26.2)	1.385 (.4)

[a] Error rates are given in parentheses.
[b] This stimulus type required a yes response in this judgment task; all other stimulus types required a no response.

revealed significant differences in error rates in the following cases. In the antonym task, error rates were higher for pseudoantonyms than for other nonantonym pairs, whereas in the synonym task, error rates were higher for pseudosynonyms than for other nonsynonym pairs. Comparing across tasks, error rates for pseudoantonyms were higher in the antonym than in the synonym task and higher for pseudosynonyms in the synonym than in the antonym task.

Comparison of error rates for yes and no stimuli by simple effects tests revealed significant differences in the following instances: In the synonym task, the error rate for yes stimuli (synonyms) was higher than that for the antonym, pseudoantonym, and unrelated pairs, and lower than that for the pseudosynonyms. In the antonym task, the error rate for yes stimuli (antonyms) was lower than that for the pseudoantonyms. The mean latency of errors in the antonym judgment condition was 1.247 sec for antonyms (based on the data of 12 subjects), 1.353 sec for synonyms (based on 9 subjects), and 1.584 sec for pseudoantonyms (based on all subjects). Error latency for synonym judgments was 1.503 sec for synonyms and 1.819 sec for pseudosynonyms.

Discussion

The results of Experiment 3 support the conclusion that both antonym and synonym judgments are affected by relationship similarity but not by item similarity. This conclusion is based on two types of comparisons made on the present data. First, the no responses may be compared across stimulus types separately for the antonym task and the synonym task. In the antonym task, responses were slowest for pseudoantonyms, indicating an effect of relationship similarity, whereas response times for synonyms, pseudosynonyms, and unrelated pairs did not differ. Since the latter relationships differ in item similarity, the absence of a difference between them indicates that item similarity did not affect response times. Similarly, responses were slowest to pseudosynonyms in the synonym task, indicating an effect of relationship similarity, but antonyms, pseudoantonyms, and unrelated pairs did not differ. These latter relationships differ in item similarity, so the absence of a difference between them indicates that item similarity did not affect response times in the synonym task. In short, the effect of the pseudorelationship stimulus types in each task indicates an effect of relationship similarity, whereas the absence of any other differences indicates the absence of an effect of item similarity.

Second, latencies may be compared across the antonym and synonym tasks separately for each of the five stimulus types. Of those stimulus types that received no responses in each task, only the pseudorelations differed significantly in the two tasks; responses to pseudoantonyms were slower in the antonym task than in the synonym task, and responses to pseudosynonyms were slower in the synonym than in the antonym task. Pseudorelation stimuli received slower responses when their relationship was similar to the relationship being judged than when their relationship was not similar, an effect of relationship similarity. Responses to unrelated pairs did not differ in the two tasks because these pairs possessed no relationship similarity in either task.

The findings of the present three experiments for both antonym and synonym judgments resemble results obtained in categorization (Smith, 1977) and synonym tasks (Herrmann et al., 1978). Yes responses are facilitated and no responses are impeded by similarity to the relationship being judged. These parallels suggest that current semantic-memory models that have been designed to account for categorization effects might provide general accounts of semantic judgments if they were modified to make relationship similarity the critical variable. Such a modification would involve the alteration of categorization models (a) to invoke different criteria for antonym, synonym, and category judgments and (b) to classify stimuli according to the degree to which the relationship between two stimulus words meets the criteria for the task. It is beyond the scope of this article to explain how each of the current models might be appropriately altered, but an example will be given for one model, that proposed by Smith et al. (1974).

The Smith et al. model, revised to account for antonym judgments, is shown in Figure 1. The first stage of this antonym-judgment model assesses the overall degree of opposition between two words. The criteria used for evaluating the degree of opposition are those described in the Introduction: presence of a dimension of opposition, number of opposed values on the dimension of opposition, symmetry of the opposed values, and extremeness of the opposed values. A low degree of opposition results in a fast no response (synonyms and unrelated pairs); a high degree of opposition results in a fast yes response (high antonym pairs). Pairs with intermediate levels of opposition are forwarded to a second processing stage (low antonym pairs and pseudoantonyms) and receive slower responses. The second stage of the model determines whether the opposition present constitutes antonymy. The analysis in Stage 2 determines whether opposition occurs on features representing the denotative meaning of both members of the pair. Pairs opposed on denotative features (antonym pairs) receive yes responses from Stage 2; pairs whose opposition does not involve denotative features (pseudoantonym pairs) receive no responses.

Stage 2 of the antonym judgment model resembles that for category judgments in that both involve a detailed semantic analysis. The higher error rate to pseudoantonyms and low antonym pairs reported here indicate that Stage 2 of antonym judgments may be more error prone than Stage 2 of category judgments. Antonym judgments result in more errors than category judgments because the antonym task makes Stage 2 processing more vulnerable to mistakes. In a same/different categorizations task, the subject decides whether two words share the same superordinate, which is either unspecified (e.g., Herrmann et al., 1975) or is given on every trial (e.g., Shoben, 1976). Error rates in this task are higher when the superordinate is unspecified (10% in the study of Herrmann et al., 1975), than when specified (5% in Shoben, 1976). Thus, when a subject must discover the criterial superordinate in a categorization task, errors are more likely to occur. Similarly, in an antonym task, the subject decides whether two words share a denotative dimension of opposition that is unspecified and must be discovered. It is easy to be mistaken about the dimension of opposition, particularly when one or both words are polysemous. For example, the words *monotonous–changing* are antonyms if one considers the sense of monotonous that means unchanging but not if one considers the sense in which it means boring. Thus, the slow errors to low antonym pairs and pseudoantonyms can be attributed to difficulty in identifying the dimension of opposition in Stage 2.

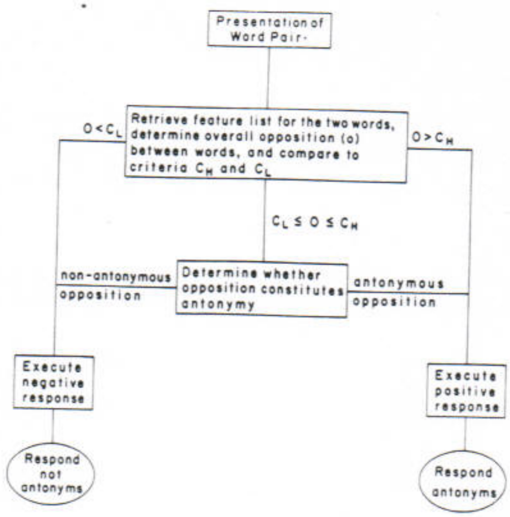

Figure 1. A two-stage feature comparison model for decisions in antonym judgment tasks. (C_L stands for a no-response criterion based on a low degree of opposition and C_H stands for a yes-response criterion based on a high degree of opposition.)

The Smith et al. (1974) model, when altered to process relationship similarity, can account, not only for antonym judgments but also for synonym judgments. The results for the synonym task in Experiment 3 showed that synonym judgments are based on relationship similarity. In the synonym task, stimulus relationships must, therefore, be evaluated against criteria for synonymity. To account for the present results, the Smith et al. model must be revised to make Stage 1 an evaluation of the proportion of common features and the proportion of common features with similar codings. Stimulus pairs with few common features (unrelated pairs) or with opposed values on common features (antonyms and pseudoantonyms) receive fast no responses; pairs with a high proportion of common features with similar values (high synonym pairs) receive fast yes responses. Pairs with an intermediate proportion of common features with similar values (pseudosynonyms and low synonym pairs) are forwarded to the second stage, which determines whether the common features are denotative for both words (Herrmann, 1978). The model predicts the results for the synonym task in Experiment 3: fast no responses for antonyms, pseudoantonyms, and unrelated pairs and slow no responses for pseudosynonyms (cf. Sabol & DeRosa, 1976). The model also predicts faster yes responses for high than for low synonym pairs (Herrmann et al. 1978).

The preceding discussion has shown that the Smith et al. (1974) model can be modified to account for similarity effects in antonym and synonym tasks by replacing item similarity with relationship similarity. Parallel effects of similarity also occur in categorization tasks and, therefore, category judgments might also be accounted for in terms of relationship similarity. Such an account is implicit in the description of Stage 1 given by Smith et al., even though the authors used ratings of item similarity to predict the outcome of this stage of processing. The similarity evaluation that Smith et al. describe for Stage 1 involves considering denotative similarity between stimulus items. Since the presence of common denotative features is one criterion for category membership, Stage 1 of Smith et al.'s model might be regarded as one in a series of tests for relationship similarity. Viewed in this way, the Smith et al. model is consistent with the present proposal that latency of semantic judgments is a function of relationship similarity. Further research is needed to determine whether relationship similarity is processed in categorization tasks as suggested here.

If antonym, synonym, and categorization judgments can be accounted for in terms of relationship similarity, it would be reasonable to assume that the Smith et al. (1974) model could be extended to account for other semantic judgments. This could be done by invoking appropriate criteria for each relationship, for example, universal and existential quantification (Glass & Holyoak, 1974, 1975) and judgments about properties (Collins & Quillian, 1969). Other categorization models besides that of Smith et al. could be similarly modified, although the plausibility of such extensions might vary. (See models of Collins & Loftus, 1975; Gellatly & Gregg, 1977; Glass & Holyoak, 1974/1975; McClosky & Glucksberg, 1979; Meyer & Schvaneveldt, 1976.)

In summary, the present research has demonstrated parallels between antonym and synonym decisions and categorization decisions. These parallels suggest that a general account could be given of these relationship judgments. For current categorization models to provide a general account of semantic decisions, item similarity must be replaced by relationship similarity as the central variable in each model, making the specific operations of a model (whether expressed as feature comparisons, evidence evaluated, or paths searched) dependent on the relationship being judged.

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Received May 21, 1979 ■